

CLAIMS:

1. Method for monitoring a scanning probe tracing a surface of a sample, the method comprising the steps of:
 - splitting a light beam reflected off a tip of the scanning probe into two beams with different path lengths and recombining the split beams to form an interference beam;
 - illuminating the interference beam on a photodetector, said photodetector providing a signal responsive to the interference beam; and
 - processing the response signal to represent a characteristic of the sample surface.
2. The method according to claim 1, wherein the probe is a cantilever suitable for use in an atomic force microscope, said probe having a sensing tip near the free end of the cantilever, said sensing tip is disposed proximate to the sample surface and the cantilever reflection surface is opposite the sensing tip.
3. The method according to claim 1, wherein the steps of splitting and recombining the reflected light beam are carried out in an interferometer.
4. The method according to claim 3, wherein said interferometer comprises a first mirror mounted on a first actuator operable to adjust the period and/or orientation of the fringe pattern of said interference beam.
5. The method according to claim 3, wherein said interferometer comprises a second mirror mounted on a second actuator.
6. The method according to claim 5, wherein said second actuator is operable to modulate the fringe pattern of said interference beam and to cancel out noise in said scanning probe.
7. The method according to claim 1, wherein said scanning probe or sample is mounted on a piezoelectric system.

8. The method according to claim 7, further comprising the step of outputting the signal to a position control system to provide a position signal operable to drive said piezoelectric system.
9. The method according to claim 7, further comprising the step of generating raster signals to said piezoelectric system to scan a surface of the sample.
10. The method according to claim 1, further comprising the step of modulating the fringe pattern of the interference beam with a transmission grating.
11. The method according to claim 10, wherein said modulation allows noise cancellation in said scanning probe.
12. The method according to claim 10, wherein said modulation adjusts the period and/or orientation of said interference fringe pattern.
13. The method according to claim 10, wherein said transmission grating is mounted on a rotatable ring operable to align the grating orientation with the orientation of the fringes of said interference beam.
14. The method according to claim 13, wherein said alignment allows separate characteristic to be obtained according to the bending mode or torsion mode of said probe.
15. The method according to claim 10, further comprising the step of reducing the cross-sectional area of said interference beam so that the entire beam illuminates said photodetector by providing a first lens upstream of said transmission grating.
16. The method according to claim 10, further comprising the step of reducing the cross-sectional area of said interference beam so that the entire beam illuminates the photodetector by providing a second lens downstream of said transmission grating.
17. The method according to claim 10, further comprising the step of reducing the cross-sectional area of said interference beam so that the entire beam illuminates the photodetector by providing a lens downstream of said transmission grating.

18. The method according to claim 1, wherein a plurality of light beams, a plurality of scanning probes and a corresponding plurality of photodetectors are provided for array scanning.
19. The method according to claim 1, wherein said characteristic of said sample surface comprises one of the following: force; topography; electric field; magnetic field; chemical affinity.
20. The method according to claim 1, wherein said characteristic is an area profile or line profile of said sample surface.
21. A system for a scanning probe microscope comprising:
interferometer means for converting a light beam reflected off a probe into an interference beam;
detecting means for outputting a signal responsive to said interference beam incident on said detecting means; and
processing means operable on said response signal to represent a characteristic of said sample surface.
22. A system according to claim 21, wherein said interferometer means comprises a first reflecting means mounted on a first actuating means, said first actuating means is operable to adjust the period and/or orientation of the fringe pattern of said interference beam.
23. A system according to claim 21, wherein said interferometer means comprises a second reflecting means mounted on a second actuating means.
24. A system according to claim 23, wherein said second actuating means is operable to modulate the fringe pattern of said interference beam and to cancel out noise in said scanning probe microscope.
25. A system according to claim 21, further comprising a grating means disposed in the path of said interference beam.

26. A system according to claim 25, wherein said grating means is mounted on a rotatable ring operable to align the grating orientation with the orientation of the fringes of said interference beam.

27. A system according to claim 25, wherein said grating means is mounted on a third actuating means operable to modulate the fringe pattern and to cancel out noise in said scanning probe microscope.

28. A system according to claim 25, further comprising a first lens disposed in the path of said interference beam upstream of said grating means to reduce the cross-sectional area of said interference beam, so that the entire beam illuminates the detecting means.

29. A system according to claim 25, further comprising second lens disposed in the path of said interference beam downstream of said grating means to reduce the cross-sectional area of said beam, so that the entire beam illuminates the detecting means.

30. A system according to claim 25, further comprising a lens disposed in the path of said interference beam downstream of said grating means to reduce the cross-sectional area of said beam, so that the entire beam illuminates the detecting means.

31. A system according to claim 21, wherein a plurality of light sources, a plurality of probes and a corresponding plurality of detecting means are provided for array scanning.

32. A system according to claim 21, wherein said characteristic is an area profile or a line profile of said sample surface.

33. A scanning probe microscope comprising:
an interferometer for converting a light beam reflected off a probe into an interference beam;
a photodetector for outputting a signal responsive to said interference beam incident on said photodetector; and
a processor operable on said response signal to represent a characteristic of said sample surface.

34. A microscope according to claim 33, wherein on said interferometer comprises a first mirror mounted on a first actuator, said first actuator is operable to adjust the period and/or orientation of the fringe pattern of said interference beam.
35. A microscope according to claim 34, wherein said interferometer comprises a second mirror mounted on a second actuator, said second actuator is operable to modulate the fringe pattern and to cancel out noise in said microscope.
36. A microscope according to claim 33, further comprising a transmission grating disposed in the path of said interference beam.
37. A microscope according to claim 36, wherein said transmission grating is mounted on a third actuator.
38. A microscope according to claim 37, wherein said third actuator is operable to modulate said fringe pattern of said interference beam and to cancel out noise in said microscope and said characteristic thus obtained.
39. A microscope according to claim 36, wherein said transmission grating is disposed on a rotatable ring operable to align the grating orientation with the orientation of the fringes of said interference beam.
40. A microscope according to claim 39, wherein said alignment allows separate characteristic to be obtained according to pure bending or pure torsion of said scanning probe.
41. A microscope according to claim 33, further comprising one or more lens disposed in the path of said interference beam to reduce the cross-sectional area of said interference beam, so that the entire beam illuminates said photodetector.
42. A microscope according to claim 33, wherein a plurality of light sources, a plurality of probes and a corresponding plurality of photodetectors are provided for array scanning.